

Characteristics of Sea Breeze in PRD Region and its Response to Urbanization

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Abstract:

Pearl River Delta (PRD) region has experienced fast economic development since 1980s and becomes one of the world's largest industrial zones and metropolitan areas. However severe air pollution problems such as high concentration of ozone and particulate matter arise with the rapid urbanization and industrial development. According to previous studies, sea breeze circulation can contribute to pollutant transportation and convective initiation, so it is meaningful to study the dynamical structure of sea-breeze circulations in PRD region. Many researchers have focused on the effects of environmental factors, such as topography, urbanization and background wind, on sea breeze, but most of them only focused on case studies and did not quantify the characteristics of sea breeze circulations (including start time, end time, strength, height, occurrence frequency and inland penetrating distance).

In this research one method to quantify the characteristics of these sea breeze cases has been identified. The coastal lines in PRD region are simplified into one heptagon which almost covers the Pearl River Estuary and the positive diurnal signals of wind flux over the heptagon are taken as sea breeze cases. Similarly, the complex coasts along Guangdong province are enclosed by two rectangles and the positive diurnal signals of averaged inshore divergent wind in these two rectangles are considered as sea breeze cases. This method has been applied to analyze sea-breeze events in 2012 and preliminary results indicate that this method can quantify the characteristics of sea breeze circulations well.

This research also focuses on case study. In one typical sea-breeze case, prognostic variables like circulation, circulation acceleration and solenoid term can be evaluated. Preliminary results imply that solenoid term is mainly controlled by vertical temperature gradient, while diabatic heating and tilting are the two most important factors for the development of vertical temperature gradient. This research can also evaluate the implication of urbanization on sea breeze circulation quantitatively with frontogenesis function. It is expected that this research will demonstrate the mechanism in which sea breeze circulation can be modulated by urbanization.

Keywords: Sea-breeze Circulation, Urbanization, PRD Region, Solenoid term

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